THE FORMS OF THE RING AND DUMB-BELL NEBULAS.—In a recent number (539) of the *Astronomical Journal* Prof. J. M. Schaeberle stated that by using a short focus reflector he had obtained photographs of the Ring nebula which plainly showed that this object had a clockwise spiral form. In several fainter photographs obtained since, where faint nebulosities are shown only at the extremities of the major axis of the ellipse, he noticed a decided similitude in shape to the dumb-bell nebula in Vulpecula, and was induced to photograph the latter object in order to see if that, too, was a spiral; the photographs obtained show that it is, but in this case the spiral is counter-clockwise.

From these photographs of the two objects Prof. Schaeberle concludes that they were formed, in each case, by simultaneous emissions of matter from a central mass, several streams leaving the parent body in diametrically opposite directions, and with various velocities, at the same time and forming inner and outer streams of which the inner would travel round the central body several times while the outer streams were making one revolution; where these two streams meet and are superimposed, the nebulosity is much brighter, and exhibits the forms usually attributed to these objects. If we suppose that the outer boundary of the nebula, as it is usually seen, represents the exterior limit of the inner streams, and that the general arrangement of the nebula is due to gravitational forces, this theory demands that the outer streams should extend much further than is generally shown on photographs, and, in proof of this, Prof. Schaeberle has obtained photographs which show that various exterior nebulosities, and many of the adjacent faint stars, are probably part of one huge structure of which the Ring nebula is only the central condensation.

Similar proofs have been obtained to show that the formation of the Dumb-bell nebula may be explained by the same hypothesis, for on several photographs it is plainly seen that various wisps of nebulosity, which are concave towards the Dumb-bell and include several streams of faint stars, are, with the Dumb-bell, probably parts of the same original mass (*Astronomical Journal*, No. 547).

BIOLOGICAL WORK IN SOUTH AFRICA.

THE issue of the report of the Government biologist (Dr. J. D. F. Gilchrist) of the Cape of Good Hope for 1901 affords a favourable opportunity for directing attention to the energy with which biological investigations are being carried on in South Africa. Several volumes of the excellent "Fauna of South Africa," under the editorship and part authorship of Mr. W. L. Sclater, director of the Cape Town Museum, have from time to time been reviewed in our columns, where reference has likewise been made to various papers in *Marine Investigations in South Africa*, the *Annals* of the South African Museum, and other local publications. From some of these notes we venture to repeat extracts on the present occasion. It may be added that, apart from local publications, Mr. O. Thomas, of the British Museum, in papers published in the *Annals and Magazine of Natural History*, has been able to increase our knowledge of the mammals of South Africa, thanks to collections sent to this country by Colonel Slogget, R.A.M.C.

The Government biologist commences his report with an account of the trawling operations recently undertaken off the Natal coast at the request of the Government of that flourishing colony. The Natal coast is by no means promising for trawling, and as much money had been spent on previous occasions with no good results, and the recent trip proved equally unsatisfactory, the Government was advised to devote its attention to the development of line fishing, and to rely on the Cape trawling-grounds for its supply of soles. During the operations many new forms of marine life were procured, which are being investigated by specialists. On the return of the surveying vessel to Cape waters, a new trawling-ground was discovered, which promises to yield a valuable supply of food-fish.

As regards inland-fisheries, breeding operations have been seriously hampered owing to the hindrances inseparable from the institution of martial law in the country, while an unfortunate case of poisoning did not tend to mend matters. Nevertheless, the director is able to report that the rainbow-trout are in a very satisfactory condition, and that carp are likewise flourishing.

The report includes a reprint from *Marine Investigations* of Mr. R. Kirkpatrick's first paper on the sponges obtained during the Natal and Cape cruises. The third part of this contribution (*Marine Investigations*, vol. ii. part iii.) is just to hand. Several genera and many species are described as new, and the author directs attention to a notable resemblance between the sponge-fauna of South Africa and that of Australia.

A second paper reproduced in Dr. Gilchrist's report is one by Mr. G. B. Sowerby on South African molluscs, in which is described a new species of Volutilithes, making the third existing representative of that genus, which was first described from the Barton Clay. Another contribution to this subject by the same author appears in vol. ii. of *Marine Investigations*, where a number of new forms of Pleurotoma and Conus, as well as representatives of other genera, are described.

In the same volume the South African corals of the genus Flabellum receive attention at the hands of Mr. J. S. Gardiner who pays special attention to the anatomy and development of these organisms, and emphasises the importance of studying the polyp as well as the corallum if we hope to gain any real idea of their true relationships.

This volume of *Marine Investigations* also contains some valuable notes by Dr. Gilchrist on the development of South African fishes. These notes have an important bearing on certain disputed points connected with the Cape fisheries. Many fishermen urge, for instance, that the spawn of several of the commoner food-fishes is developed on or near the sea-bottom, and is, in consequence, seriously damaged by trawling. To this the author replies that, since in northern waters it has been demonstrated that only one valuable food-fish, the herring, has deep-lying spawn, and since the Cape seas are the home of only a small species of herring of little or no commercial value, it is probable that the damage done by trawling in South African waters has been overestimated.

Under the title of "Rhynchotal Miscellanea," Mr. W. L. Distant, in the *Annals* of the South African Museum (vol. ii. pt. ix. art. 12 and vol. iii. pt. ii. art. 3), publishes a series of notes on the bugs of the country, with descriptions of some new genera and a large number of new species.

In vol. iii., part iii., of the same publication, Mr. G. A. Boulenger describes six new forms of perch-like fishes from the Natal coast, all of which are illustrated in well executed plates, and belong to previously known generic types.

Part iv. art. 5 of the same volume is devoted to descriptions by Dr. W. F. Purcell of new spiders from South Africa belonging to five families.

We must likewise refer to a communication in the *Agricultural Journal* of the Cape of Good Hope for October last, in which the Government entomologist, Mr. C. P. Lounsbury, records an important discovery in regard to the propagation of the South African sheep and goat disease known as "heartwater." The bont-tick has been found to be the only medium of spreading the disease. A single specimen, if fed on a heartwater-sick animal as a larva or "seed" tick, is capable of transmitting the fatal malady. An animal pastured on veld infested by tick may drop thousands of larvæ during its illness, and thus serve for the extermination of a flock. The mortality amongst flocks brought to the coast where the tick is abundant is thus explained. Pathogenic larvæ retain their dangerous character until adult. They may take their second feeding on an ox or a non-susceptible goat, and in the final stage get on to a susceptible sheep or goat and give it fever. On the other hand, the disease appears non-transmissible through the egg-stage, and the species is normally non-pathogenic in all stages. A farm may be infested with bont-tick, yet be free from heartwater. Since the other common species are innocuous, it is hoped that by keeping down the bont-tick the disease may be stamped out.

By no means the least important memoir in the series before us is one by Mr. A. C. Seward on the fossil floras of Cape Colony, forming part i. art. 1 of the fourth volume of the *Annals*. The first section deals with the flora of the Uitenhage series, which is regarded as of Wealden rather than of Jurassic age. The Stormberg, or upper

division of the Karu, flora, on the other hand, is classed as Rhætic, while the Ecca, or lower Karu, flora is identified with some part of the Permo-Carboniferous. The latter conclusion, it may be mentioned, is rendered practically certain by the recent discovery in Kashmir of Glossopteris below marine Permian strata, as recorded in the report of the Geological Survey of India for 1902–3. The occurrence in the Ecca beds of Vereeniging of Sigillaria and other European Carboniferous types points to a closer connection between the South African Glossopteris flora and the Carboniferous flora of the northern hemisphere than exists between the latter and the Glossopteris flora of the Lower Gondwanas of India. The Ecca beds of Vereeniging appear to be the equivalents of the Karharbari beds of the Gondwanas. Finally, although deprecating a precise identification, Mr. Seward is of opinion that the Witteberg flora is probably Carboniferous or Devonian—more likely the latter than the former.

That so much good work—both strictly scientific and economic—should have been accomplished during and so soon after a great war is a hopeful sign for the future of South African biology. R. L.

EXPERIMENTS ON WHEAT.

WITHIN the last few years it has gradually been recognised that, although our wheat-fields produce a large bulk of grain, it is, if used alone, unsuitable for the manufacture of the light white bread now generally demanded. In consequence, increasing quantities of the harder and more suitable wheats grown in Canada, the United States and other countries are imported yearly, and the price of the inferior home-grown grain has fallen considerably. More or less concurrently with this greatly improved methods of milling have come into vogue, and the farmer, perhaps not unnaturally, associates the two facts, and all too frequently blames the miller for his reduced margin of profit. A little closer examination of this complicated problem shows that the tendency for the last thirty years or so has been for the yield per acre of grain to rise, and the quality, as estimated by the percentage of gluten present, to fall.[1]

Now in some way or other, precisely how we do not know, the capacity of wheat to yield a strong flour, or its "quality," is bound up in this mysterious mixture of proteids grouped together as gluten, so that if the blame must be apportioned, it rests on those who injudiciously selected wheats for cropping power in preference to quality. Meanwhile, such fine old varieties as Golden Drop, Red Lammas, and Nursery wheats are steadily being driven out of cultivation by varieties slightly superior in yield, but far poorer in quality.

The great importance of making the most of our home wheat-supply has been insisted on time after time by the National Association of British and Irish Millers, and one of the methods they have suggested is to raise improved strains of these good varieties, either by hybridising or by selection. Experiments along these lines have been carried out for the last three seasons by the Cambridge University Department of Agriculture. In the first place wheats known to yield a good quality grain have been crossed together with the object of finding more vigorous races among the progeny of the hybrids. Further, varieties selected from a collection of several hundreds for possessing such characters as a strong, resilient straw, a short period of maturation, and freedom from various diseases, have also been used as parent wheats.

So far it is early to predict any results of technical value, but a number of results of scientific interest have already been arrived at in connection with Mendel's laws of inheritance. The flowers of wheat being autogamous are specially advantageous for such work, as Spielman's careful researches on wheat-breeding, carried out without any previous knowledge of Mendel's work, have shown. Spielman has already recognised that lax ears, the lack of awns, velvety chaff, and red colour are dominant characters, while dense ears, the presence of awns, glabrous chaff and white colour are the corresponding recessive characters.

These results have already been amply confirmed.

Thus from crosses between beardless and bearded wheats the resulting hybrids have invariably shown the beardless character, while their progeny have consisted of beardless and bearded forms in the proportion of three to one. Similar results have been obtained on crossing lax and dense eared races, rough and smooth chaffed, and red and white, though in the last case it has so far been impossible, owing to bad ripening, to distinguish clearly enough between red and white chaff to establish their proportions.

At the same time it has been shown that the sharply keeled glumes found in *Triticum turgidum, e.g.* are dominant over the glumes with rounded bases occurring commonly in the varieties of *T. vulgare,* that the grey colour of glumes and paleæ is dominant over red and white, that broad leaves are dominant over narrow, and rough ones over smooth, that certain groups of bristles on the ridges of the stem which distinguish some varieties are dominant over the ridges without bristles, and that hollow stems are dominant over pithy stems. With regard to grain characters, the long and narrow type is dominant over the short and round, and the red over white. At the same time certain complications have been met with which will entail further investigation. Thus the rough-chaffed grey Rivet's wheat, when crossed with a smooth-chaffed white or red wheat, gives hybrids which vary considerably both in the roughness and colour of the chaff, some being almost glabrous and showing decidedly the red or white colour as well as the grey. The same impure dominance of the rough chaff and colour is found in the following generation. Where other rough-chaffed wheats have been made use of in the place of Rivet wheat though this character has been purely dominant.

Further, particularly among the progeny of the hybrids, there is a marked tendency for the various characters to become intensified. Medium lax, for instance, becomes very lax, the grey colour becomes almost black, and the red a deep brown. At the same time, unexpected forms appear in this generation showing characters unrepresented in either parent. The commonest of these, so far, has been a spelt-like wheat with peculiarly lax ears, thick glumes, and the typically closed spikelets of *T. spelta.* Many of these exceptional forms are sterile—probably owing to imperfectly developed pollen.

These botanical characteristics are, however, of little importance technically, the farmer and miller being concerned chiefly with the quality, yield, hardiness, time of ripening, susceptibility to disease, &c., characteristics, at present practically unexamined, which one might term "constitutional."

The quality of the grain can, to a certain extent, be judged by the hardness and translucency of its endosperm, the poor starchy grain being soft and opaque. Accepting this as a guide, then, good quality is a dominant character, at all events so far as an examination of the first generation of the hybrids goes. The late ripening habit is also dominant over the early ripening habit. As an example, *T. Polonicum,* ripening early in August when sown about the middle of March, was crossed with Rivet wheat ripening late in August when autumn sown. The hybrid grains were sown on March 15, and produced plants which ripened their grain about the middle of September—simultaneously with Rivet wheat sown on the same date.

Experiments on the susceptibility to disease are also being carried out. This point is being investigated both with rusts and mildew, the two serious wheat diseases, inasmuch as they are untreatable. For the purpose of the experiment, in 1901 Michigan Bronze and a wheat with the Michigan Bronze strain in it, viz. Red King, both liable to rust, were crossed with Rivet wheat, which is practically immune. Reciprocal crosses were made in each case. The following year the hybrids were the most badly rusted plants among the experimental plots, and there was nothing to choose between the plants with Rivet wheat as male or female. Incidentally, then, it might appear to anyone who accepted Eriksson's views that in the case of Rivet wheat ♀ × Red King or Michigan Bronze ♂, the so-called "mycoplasma" had reached the hybrid grain by way of

[1] The figures are set out in detail in Girard and Lindet's "Le Froment et sa Mouture," p. 101. (Paris, 1903.)